WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care

Worksheet author(s)

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Clinical question.

EIT-013B - In BLS providers (lay or HCP) requiring AED training (P), are there any specific training interventions (I) compared with traditional lecture/practice sessions (C) that increase outcomes (eg. skill acquisition and retention, actual AED use, etc.) (O)?

Is this question addressing an intervention/therapy, prognosis or diagnosis? Intervention
State if this is a proposed new topic or revision of existing worksheet: Proposed new topic

Conflict of interest specific to this question

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet?

Perkins:
Industry: none
Intellectual: Editor Resuscitation Journal

Yeung: none

Search strategy (including electronic databases searched).

OVID Medline (including Medline 1950-August 2009; EMBASE 1988- August 2009) ("training" OR "teaching" OR "education" as text words) AND ("AED" OR "automatic external defibrillator" [MESH]).

This search identified 284 articles. After duplicate articles were removed, 171 references were reviewed for relevance. From this 21papers were reviewed and 14 included in the worksheet.

AHA Endnote library was searched with the terms "AED" and "automatic external defibrillator". All relevant references had been identified with earlier search strategies.

- **State inclusion and exclusion criteria**

Inclusion criteria: Studies describing the effect of alternative training interventions on AED skill acquisition, retention or performance.

Exclusion criteria: Purely descriptive studies of courses with no evaluation of training.

- **Number of articles/sources meeting criteria for further review:**

16 articles studies met criteria for further review.

Six of studies were LOE 1, 8 studies were LOE 2 and 3 were LOE 4. All were manikin studies.

Summary of evidence

Evidence Supporting Clinical Question

Good	**Ropollo 2007* (E1, E2) Reder 2006* (E1, E2)**				
Fair	**De Vries 2008+ (E1)**	**Beckers 2005# (E1) Beckers 2005# (E1, E2) Castren 2004* (E1) Jerin 1998* (E2) Mitchell 2008* (E1) Moule 2008* (E1) Xanthos 2009+ (E1)**		**De Vries 2007* (E1) Kelley 2006* (E1, E2) Gundry 1999* (E1)**	
Poor					
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation
B = Survival of event
E1 = skill acquisition
*=laypersons;
C = Survival to hospital discharge
D = Intact neurological survival
E2 = skill retention
# = healthcare students;
E = Other endpoint
Italics = *Animal studies*
+ = healthcare professionals

Evidence Neutral to Clinical question

Good					
Fair		**Mattei 2002+ (E1)**			
Poor					
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation
B = Survival of event
E1 = skill acquisition
*=laypersons;
C = Survival to hospital discharge
D = Intact neurological survival
E2 = skill retention
# = healthcare students;
E = Other endpoint
Italics = *Animal studies*
+ = healthcare professionals

Evidence Opposing Clinical Question

Good	**Meischke 2001* (E1,E2) Mancini 2009* (E1)**				
Fair	**Reder 2006* (E1, E2)**				
Poor					
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation
B = Survival of event
E1 = skill acquisition
*=laypersons;
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REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

Traditional format of AED courses

The current format of Basic Life Support and AED course outlined by ERC Guidelines 2005 lasts 'approximately half a day' and consists of 'skill demonstrations, hands-on practice and lectures'. The recommended ratio of instructors to candidates is 1:6, with at least one manikin and one AED for each group of six candidates. The format of life support courses with AED use recommended by AHA, Heartsaver AED course, is classroom-based with instructor and video, group interaction and lasts 2.5 hrs without infant CPR. There is also Heartsaver CPR & AED online course with part 1 delivers cognitive learning through Web-based, self-paced modules. (2 hours) Parts 2 and 3 require students to meet with an AHA Instructor to complete skills practice session and test.

Included studies have examined the effect of alternative training intervention on AED skill acquisition, performance and retention, these include: training by layperson; shorter instructor based training; self-training (web-based and videos) and minimal training. None of the studies were designed as non-inferiority trials.

Instructor professional background

There are 2 studies which examined the background of course instructor and its impact on AED skill. Castren (Castren, 2004, 305) conducted a non-randomised study with concurrent controls during which participants were split into two groups to be taught by either lay instructors or instructors who were health care professionals. Their BLS and AED skills were then tested in an OSCE 2-3 weeks after training session. Training format was ERC recommended 4 hour course with classroom teaching and hands on practice. AED skill score was not analyzed separately but the study found no significant difference between combined BLS/AED OSCE test score, however, the study was not designed as an non-inferiority trial. Xanthos (Xanthos, 2009, 224) conducted a randomized controlled trial during which 108 nurses were randomized to AED training by either a doctor or nurse instructor. Skill retention was measured in a written test and OSCE conducted 1 month after initial training. There was no difference found in the written test, however participants taught by nurses outperformed those taught by doctors in all 7 domains of the OSCE assessment.

Self directed learning

Computer based learning: A pilot study examined the effectiveness of a web-based BLS / AED self-training program amongst 16 lay persons (De Vries, 2007, 491). The web-based program included theory, scenario training and self-testing, but without practice on a manikin, or any instructor input. All volunteers performed the assessed skills in the use of an AED correctly but BLS skills of opening airway, ventilations and chest compression depth and rate were performed poorly. There was no association between the time a participant spent on-line and the quality of performance. The results suggest that it is possible to train people in AED skills using a micro-simulation web-based interactive program and without any practice on a manikin. Moule (Moule, 2008, 427) conducted a non-randomised study with concurrent controls in which 83 mental health staff were allocated to classroom teaching (2.5 hr lecture, n=55) or e-learning (3 hr access plus one hour manikin practice, n=22) and asked to complete a pre- and post-test questionnaire on AED use and a standardized scenario for BLS performance. The study found that e-learning group were faster to give the first shock (3.38 secs) and no difference was found for safety performance. Electrode pad placement, however, was poor for both groups. A cluster randomized study of high school students compared (1) interactive computer learning (2) interactive computer learning plus instructor led practical training (3) video based learning plus instructor led practical training (4) no training (Reder, 2006, 443). The study was supportive that some training (groups(1-3)) was better than no training (group 4) for BLS/AED skills. However hands-on practice (groups 2+3) enhanced students' performance (correct AED pad placement and CPR actions) compared to computer training only (group 1). Jerin et al (Jerin, 1998, 709) compared AED skill maintenance in emergency medical technicians (EMTs) during quarterly AED skill refresher training. Participants were allocated according to shift patterns to one of 3 groups. Two groups combined computer assisted learning with instructor facilitated learning whilst the control group involved instructor based training only. There were no differences between training groups in the increase in performance scores but the study was not based on non-inferiority design.

Video: Ropollo (Ropollo, 2007, 276) randomized 270 airline staff to traditional instructor led training (3 hours) or a 30 min video self learning course (including mankin CPR practice but not AED use). Performance following 30-min training was equivalent to the multi-hour Heartsaver-Automated External Defibrillator training in all measurements, both immediately and 6 months after training. At 6 months, 84% of the 30-min training group was judged, overall, to perform cardiopulmonary resuscitation adequately with 93% performing chest compressions adequately and 93% with correct AED skills. Meischke (Meischke, 2001, 216) randomized 210 senior citizens (average age 71) to 45 minute video or instructor led training. The study found instructor led group were slightly faster in time to first shock at both immediate evaluations and at 3 months (average time differences of <20 seconds). Skill performance showed marked deterioration with time however in both groups. Mancini (Mancini, 2009, 159) compared a self directed DVD course with un-supervised manikin practice (CPR Anytime) with DVD instructions and practice manikin, with a traditional instructor-led course. Participants were randomized according to group size and in blocks. The self directed group performed skills less well than the instructor led group (lower scores for: calling 911, delivering chest compressions of adequate depth and clearing to victim to analyse and shock). It was noted subsequently that these points were not covered in enough detail in the DVD

De Vries (De Vries, 2008, 76) examined efficacy and potential cost savings from self-training in AED use. The randomized controlled trial used BLS trained nurses to compare self directed training (with a poster and manikin practice) with traditional instructor training. There was no significant difference in AED performance found between the groups. If poster self-training were to be used instead of instructor-based courses, it was calculated that there would be a saving in costs of up to €6 for each nurse trained.

Minimal training / No Training

Kelley et al (Kelley, 2006, 299) examined learning outcomes following a condensed 1 hour BLS/AED course amongst 33 8th grade students. Initial skills assessment demonstrated that 29/33 (87.8%) students were proficient at BLS/AED following the 1 hour course. Four week later 28/33 (84.8%) students demonstrated skill retention in similar scenario testing. Students also showed improvement in written knowledge regarding AED use as shown by scores on an AHA based written exam (60.9% versus 77.3%; $p < 0.001$). However, there was no control group to compare with in this study.

Mitchell et al (Mitchell, 2008, 301) examined the effect of three types of brief training on the use of automatic external defibrillators (AEDs) by 43 lay users. The exposure training group read an article about AEDs that provided no operational instructions; the low-training group inspected the AED and read the operating instructions but was given no practice; and the high-training group watched a training video and performed a mock resuscitation using the AED but no manikin. After 2 weeks, participants were asked to perform a simulated AED resuscitation on a manikin. The results showed that most participants in each training group met minimum criteria of acceptable performance during the simulated manikin resuscitation. Time to first shock was set at 150 seconds and 92.3% of exposure only group and all participants in low and high training group performed first shock within acceptable time, however, exposure group was slower (107secs) than low and high training group (73 secs and 86 secs respectively). Training had no significant difference found in pad placement ($p>0.08$) but more training decreased errors by participants (1.43 in exposure group, 0.67 in low training and 0.31 in high training).The study concluded that although untrained users were able to adequately use this AED, additional brief training improved user time to first shock. Gundry (Gundry, 1999, 1703-1707) compared AED use of untrained children with trained paramedic using mock cardiac arrest scenario. Mean time to defibrillation was 90+/-14 s (range, 69-111s) for the children and 67+/-10 s (range, 50-87 s) for the paramedics ($P<0.0001$). Electrode pad placement and safety was appropriate for all subjects. The study found that difference between the groups is small, considering that children as untrained first-time users.

Beckers (Beckers, 2005, R110) compared AED use by medical students before and after a 15 min lecture. Time to first shock decreased significantly from 81.2 ± 19.2 sec to 56.8 ± 9.9s; $p<0.01$ with minimal theoretical training. The study also found that semiautomatic-AED was easier and quicker to use than an automatic defibrillator (before training: 77.5 ± 20.5 s versus 85.2 ± 17 s, $P \leq 0.01$; after training: 55 ± 10.3 s versus 59.6 ± 9.6 s, $P \leq 0.01$). A further study by the same group (Beckers, 2007, 444) confirmed these findings and showed that skill retention after brief (15 minute) training remained high at 6 month follow up.

Mattei et al (Mattei, 2002, 277) investigated whether nurses and physiotherapists can use an AED without prior training and found all untrained subjects could deliver a shock with an AED in 68.89±29.2s (time ±S.D., range, 40-169 s). However, they also found that most participants failed to position the pads correctly (53%) or follow correct safety procedures (67%). After a standard 6 hour training session, the time to deliver a shock improved significantly to 48.59±5.5s (range, 41-61 s, $P<0.01$) and all subjects placed the pads correctly and followed a safe defibrillation

procedure. The authors concluded that nurses and physiotherapists, with no previous AED training, can deliver a shock with an AED within a reasonable time but training improves speed of shock delivery, correct pad placement and safety.

Acknowledgements:

Citation List

Beckers 2005

Beckers S, Fries M, Bickenbach J, Derwall M, Kuhlen R and Rossaint R. Minimal instructions improve the performance of laypersons in the use of semiautomatic and automatic external defibrillators. Critical Care (2005) 9(2): R110-R116

LOE 2before (1st test with no instructions) and after effect (15min lecture no practical session, 1 use in previous test); Quality good, supportive. Also compared automatic and semi-automatic defibrillators.

Beckers 2007

Beckers S, Fries M, Bickenbach, Skorninga M, Derwalla M, Kuhlenb R, Rossainta R. Retention of skills in medical students following minimal theoretical instructions on semi and fully automated external defibrillators. Resuscitation (2002) 72:444-450

LOE 2 before (1st test with no instructions) and after effect (15min lecture no practical session, 1 use in previous test); Quality good, supportive. Randomisation only applies to semi-automatic and automatic AEDs.

Castren 2004

Castren M, Nurmi, Laakso J, Kinnunen A, Backman R, Niemi-Murola L. Teaching public access defibrillation to lay volunteers—a professional health care provider is not a more effective instructor than a trained lay person. Resuscitation (2004) 63: 305-310

LOE 2; Quality Fair, supportive. Study compared skill performance of AED use as well as quality of CPR of layperson trained by HCP or layperson instructor. OSCE score not specific to AED use.

De Vries 2007

De Vries W, Handley A. A web-based micro-simulation program for self-learning BLS skills and the use of an AED. Can laypeople train themselves without a manikin? Resuscitation (2007) 75: 491-8

LOE 4; Quality fair, supportive. Study compared BLS skills as well as AED use in layperson trained by web based program, no manikin/practice. No control group.

De Vries 2008

de Vries W, Schelvis M, Rustemeijer I, Bierens J. Self-training in the use of automated external defibrillators: The same results for less money. Resuscitation (2008) 76:76-82

LOE 1; Quality fair, supportive. Compared skill performance of BLS and AED use in self training using manikin and poster with 3 hour instructor based training. Self training is more cost effective.

Gundry 1999

Gundry J.W., Comess K.A., DeRook F.A., Jorgenson D., Bardy G.H. Comparison of naive sixth-grade children with trained professionals in the use of an automated external defibrillator. Circulation. 100(16)(pp 1703-1707), 1999.

LOE 4; Quality fair, supportive. Study demonstrated that un-trained school children could use an AED without training

Jerin 1998

Jerin J, Ansell B, Larsen M, Cummins R. Automated External Defibrillators: Skill Maintenance Using Computer-assisted Learning. Academic Emergency Medicine (1998) 5(7): 709-717

LOE 2; Quality fair, supportive. Cross over trial design, randomised according to shift work. Skill retention examined in speed and treatment categories, not individually broken down into components.

Kelley 2006

Kelley J, Richman P, Ewy G, Clark L, Bulloch B, Bobrow B. Eighth grade students become proficient at CPR and use of an AED following a condensed training programme. Resuscitation (2006) 71:229-236

LOE 4; Quality fair, supportive. No control group. Assessment of skill acquisition and skill retention at 4 weeks with written and practical session of CPR and AED skills

Mancini 2009

Mancini ME. Cazzell M. Kardong-Edgren S. Cason CL. Improving workplace safety training using a self-directed CPR-AED learning program. AAOHN Journal. 57(4):159-67, 2009

LOE 1, quality good. Opposing results in self directed group was significantly worse in calling for help, chest compression depth and clearing victim to analyse and shock. Deficiencies were found on DVD and improved upon but trial was not repeated to give results after improvement.

Mattei 2002

Mattei L, Mckay U, Lepper M, Soar J. Do nurses and physiotherapists require training to use an automated external defibrillator? Resuscitation (2002) 53:277-280

LOE 2; Quality fair, supportive for time to first shock, oppose for placement of electrodes and safety. Although time to first shock is significantly reduced by training, mean time is less than 1 minute and authors conclude that shocking with AED does not require prior training. Randomised to training (6 hr combined BLS, AED course) and no training prior to testing.

Meischke 2001

Meischke H, Rea T, Eisenberg M, Schaeffer S, Kudenchuk P. Training Seniors in the Operation of an Automated External Defibrillator: A Randomized Trial Comparing Two Training Methods. Annals Of Emergency Medicine (2001) 38(3):216-222

LOE 1; Quality fair, opposing. Unblinded study. Randomised sequentially to instructor based training (15min lecture & 30min practice) or video based training (11min video & upto 45min practice). Statistically different time intervals to delivering shock was found (20 seconds).

Mitchell 2008

Mitchell KB. Gugerty L. Muth E. Effects of brief training on use of automated external defibrillators by people without medical expertise.
Human Factors. 50(2):301-10, 2008.

LOE 2; Quality fair, Pseudorandomised trial as adjusted randomisation to ensure equal skill mix. Supportive for brief training on time to first shock.

Moule 2008

Moule P. Albarran JW. Bessant E. Brownfield C. Pollock J. A non-randomized comparison of e-learning and classroom delivery of basic life support with automated external defibrillator use: a pilot study. International Journal of Nursing Practice. 14(6):427-34, 2008 Dec.

LOE 2, quality fair. Supportive for AED performance following web-based learning. Non-randomised pilot study.

Reder 2006

Reder S, Cummings P, Quan L. Comparison of three instructional methods for teaching cardiopulmonary resuscitation and use of an automatic external defibrillator to high school students. Resuscitation (2006) 69: 443-453

LOE 1; Quality Fair, supportive. Both CPR and AED skills were tested with written and practical sessions in groups that have interactive computer learning ± instructor, video based learning ± instructor and traditional instructor based learning. Skill retention tested at 2 months due to school schedule. Key AED steps are used as outcomes: turn AED on, apply pads, press shock button when advised.

Ropollo 2007

Ropollo L, Pepe P, Campbell L, Ohman K, Kulkarni H, Miller R, Idris A, Bean L, Bettes T, Idris AH. Prospective, randomized trial of the effectiveness and retention of 30-min layperson training for cardiopulmonary resuscitation and automated external defibrillators: The American Airlines Study. Resuscitation (2007) 74: 276-285

LOE 1; Quality good, supportive. Video self instruction with no practice in 30 min compared with traditional teaching, CPR skills and AED use tested immediately and retention at 6 months. Better results for AED use immediately after training but statistically not significant. Skill retention is equivalent to traditional group.

Xanthos 2009

Xanthos T. Ekmektzoglou KA. Bassiakou E. Koudouna E. Barouxis D. Stroumpoulis K. Demestiha T. Marathias K. Iacovidou N. Papadimitriou L. Nurses are more efficient than doctors in teaching basic life support and automated external defibrillator in nurses. Nurse Education Today. 29(2):224-31, 2009 Feb

LOE 2; Quality fair, supportive. Overall score from written test and OSCE practical test compared. Better OSCE score for group taught by nurses and it includes BLS as well as AED skills.